Fish oil availability going forward

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based on a memo to the Norwegian Seafood Federation

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Fish oil availability going forward

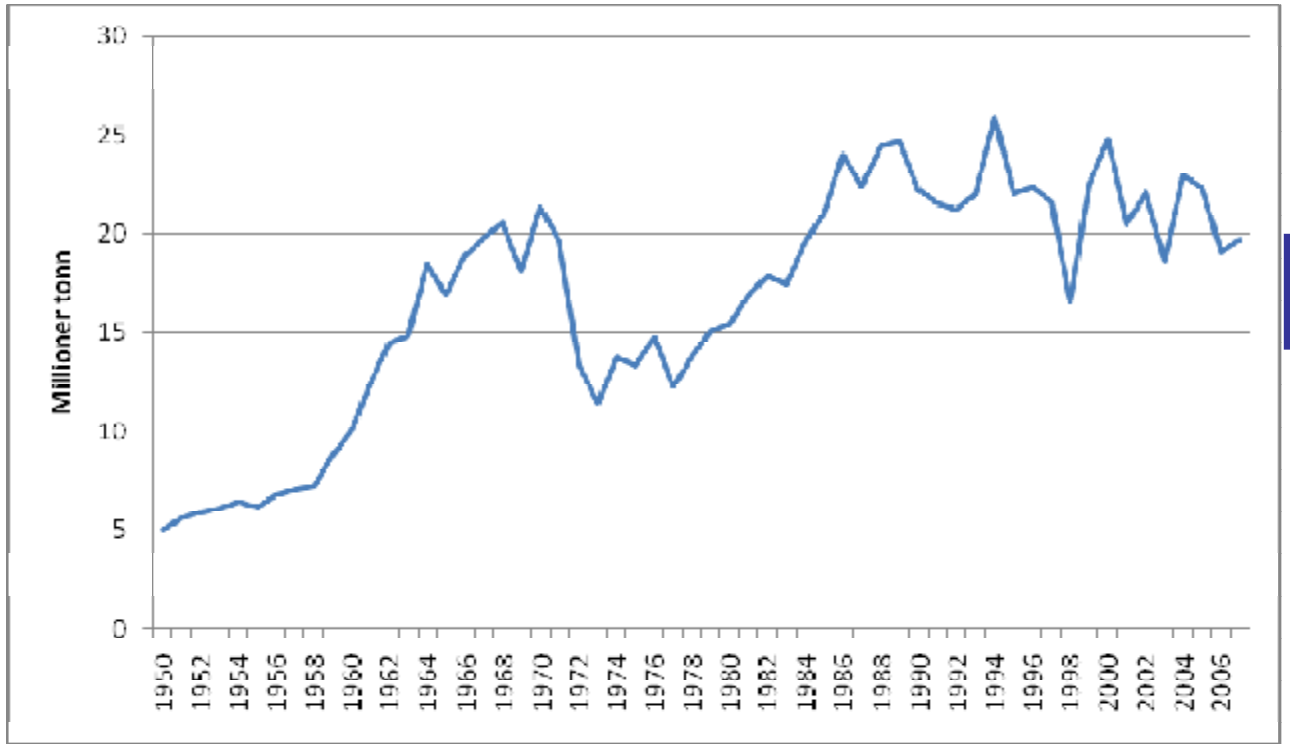
- Insufficient supply of marine oils will change the Salmon Industry
- Alternative sources with omega-3

Insufficient supply of marine oils will change the Salmon Industry

- **Stable total volumes – indicate responsible resource management**
- **Acute situation may arise in three years**
- **The potential for further substitution of vegetable oil for marine oils is uncertain**
- **A different salmon industry emerges**

Relatively stable level of catches since 1988

Global catch of pelagic fish like anchoveta, caplin, Nordic herring etc.
Tones, mill

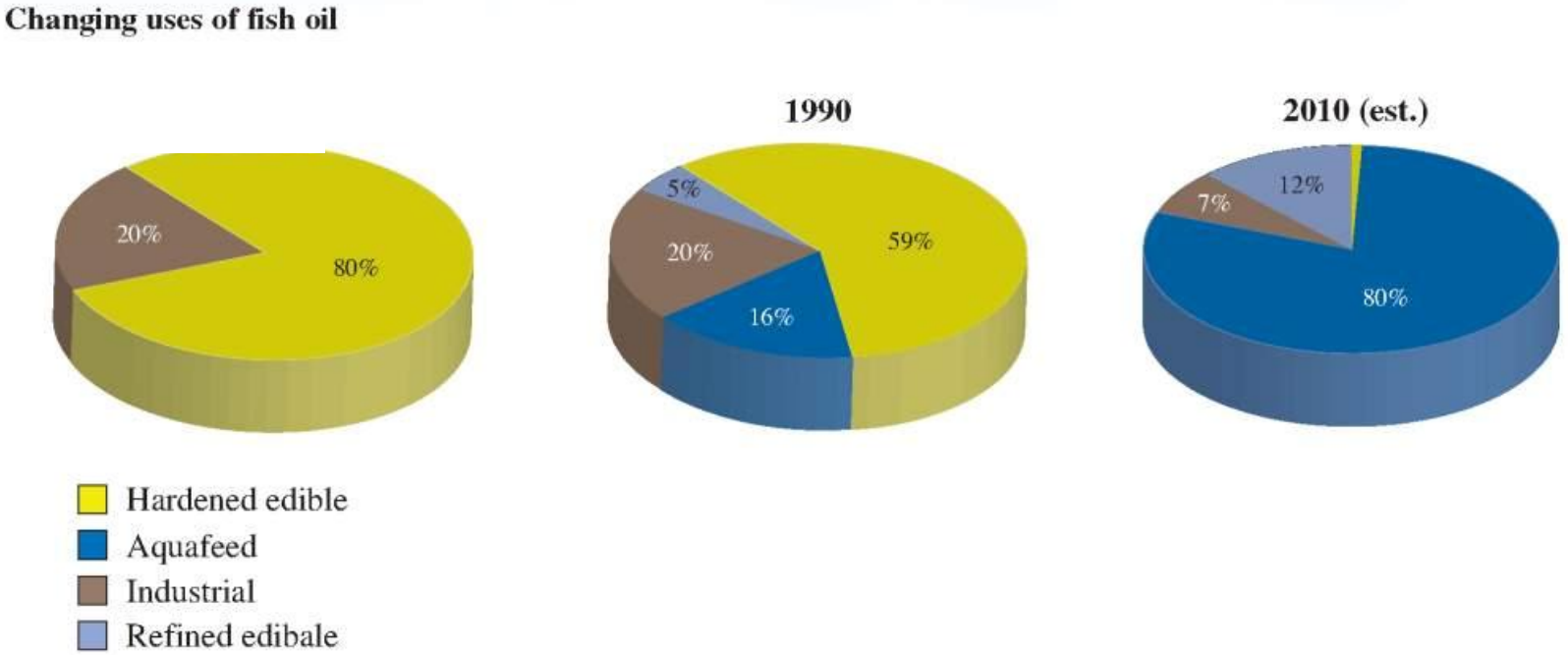


Available volumes of marine oil:

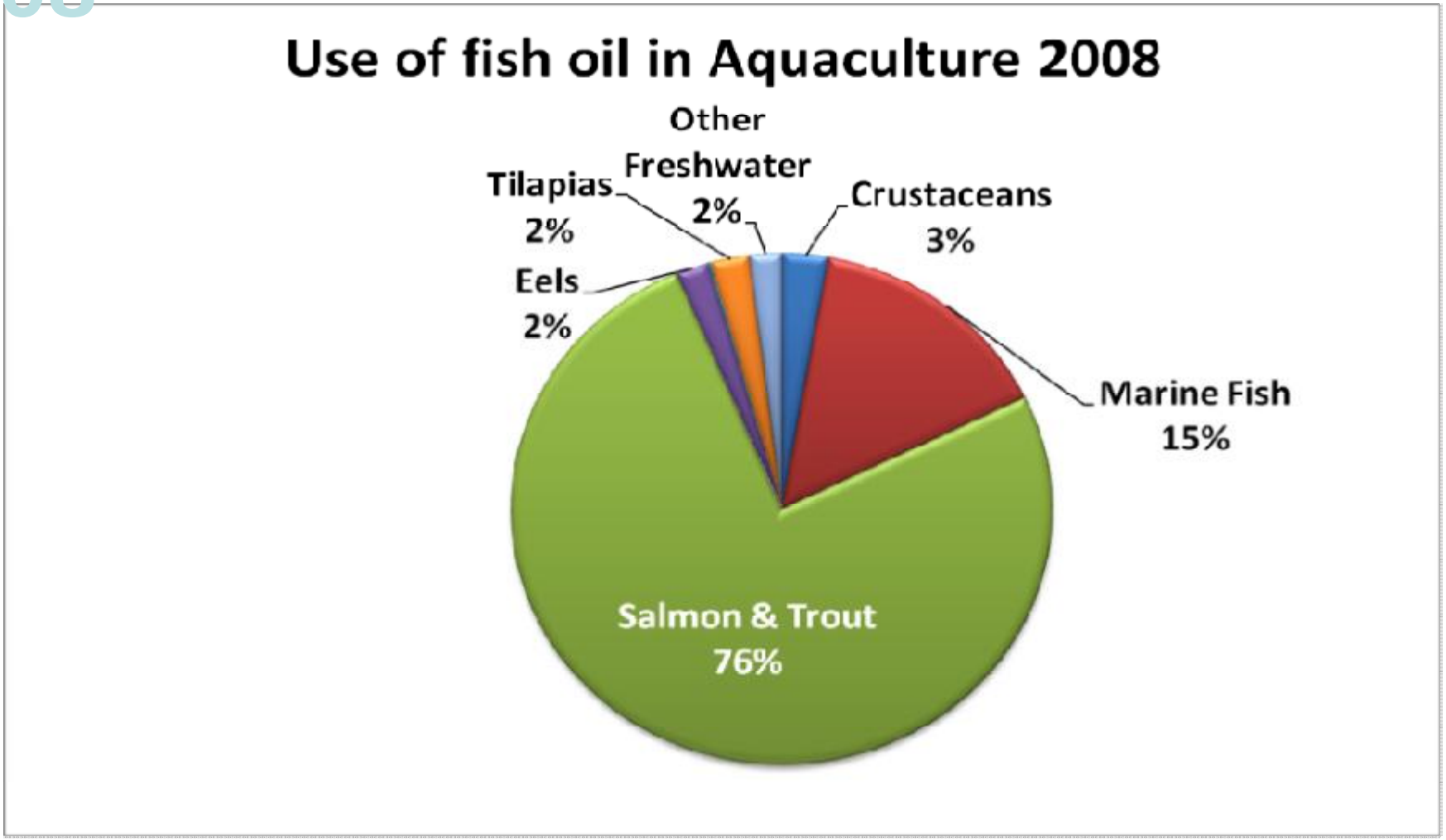
Approx 1 mill tones

Source: FAO

Changing use of FISH OIL

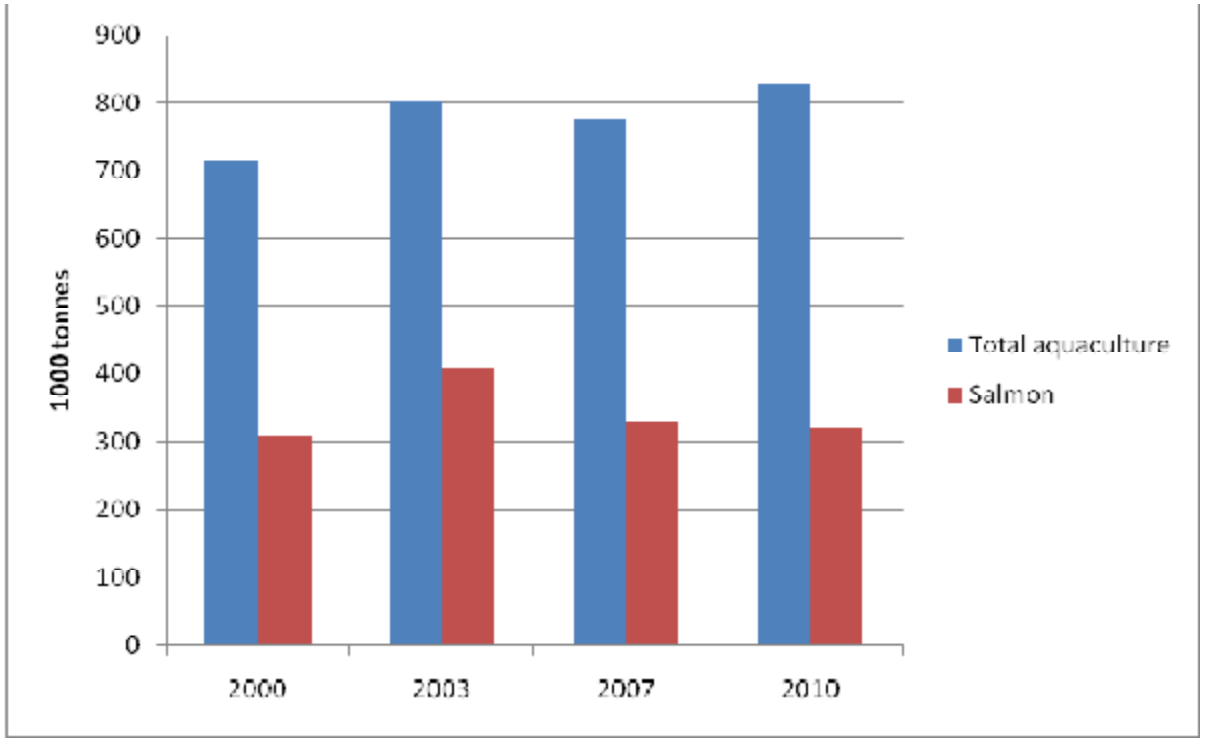


Use of FISH OIL in Aquaculture 2008



Aquaculture, of which 40 % salmon, consumes the great majority of marine oils

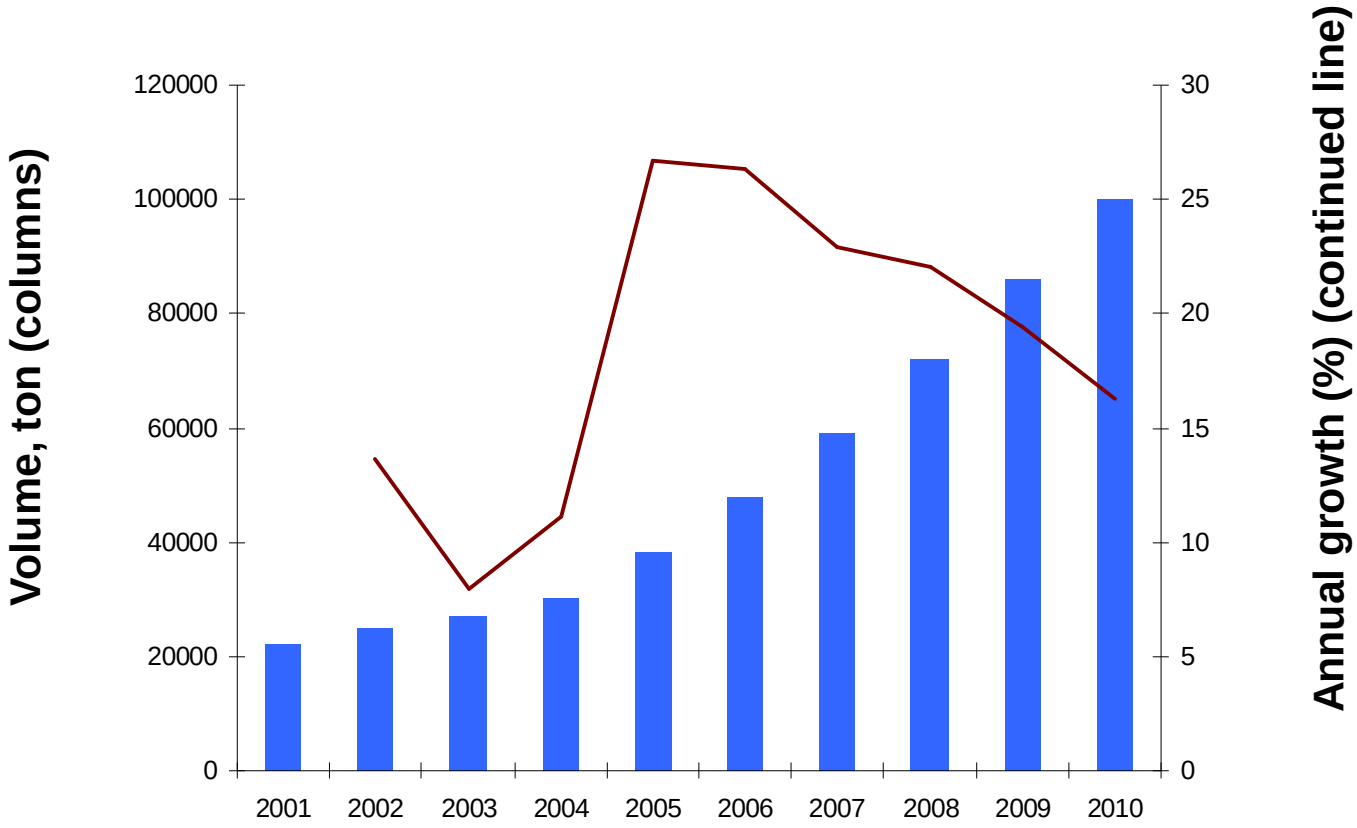
Marine oils consumed by total aquaculture and salmon



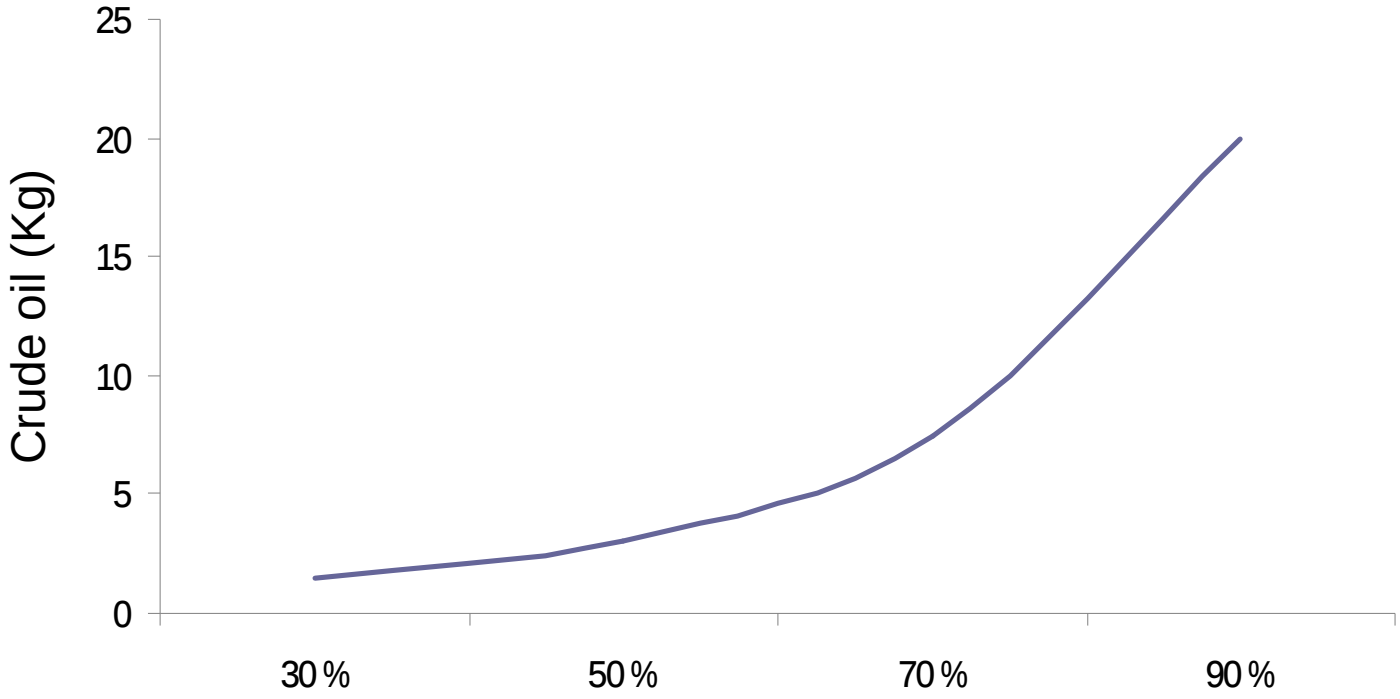
Source: IFFO estimates in Tacon & Metian, 2008

Nutritional supplements crowd out aquaculture

The global market for refined Omega 3 marine oil

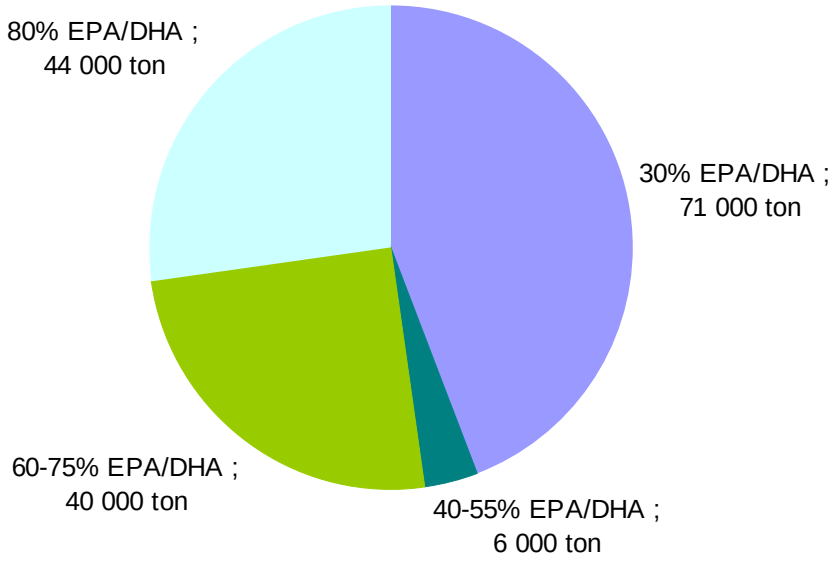


Rising rates of concentration in refined products, will greatly stimulate demand



Source: GOED, 2010

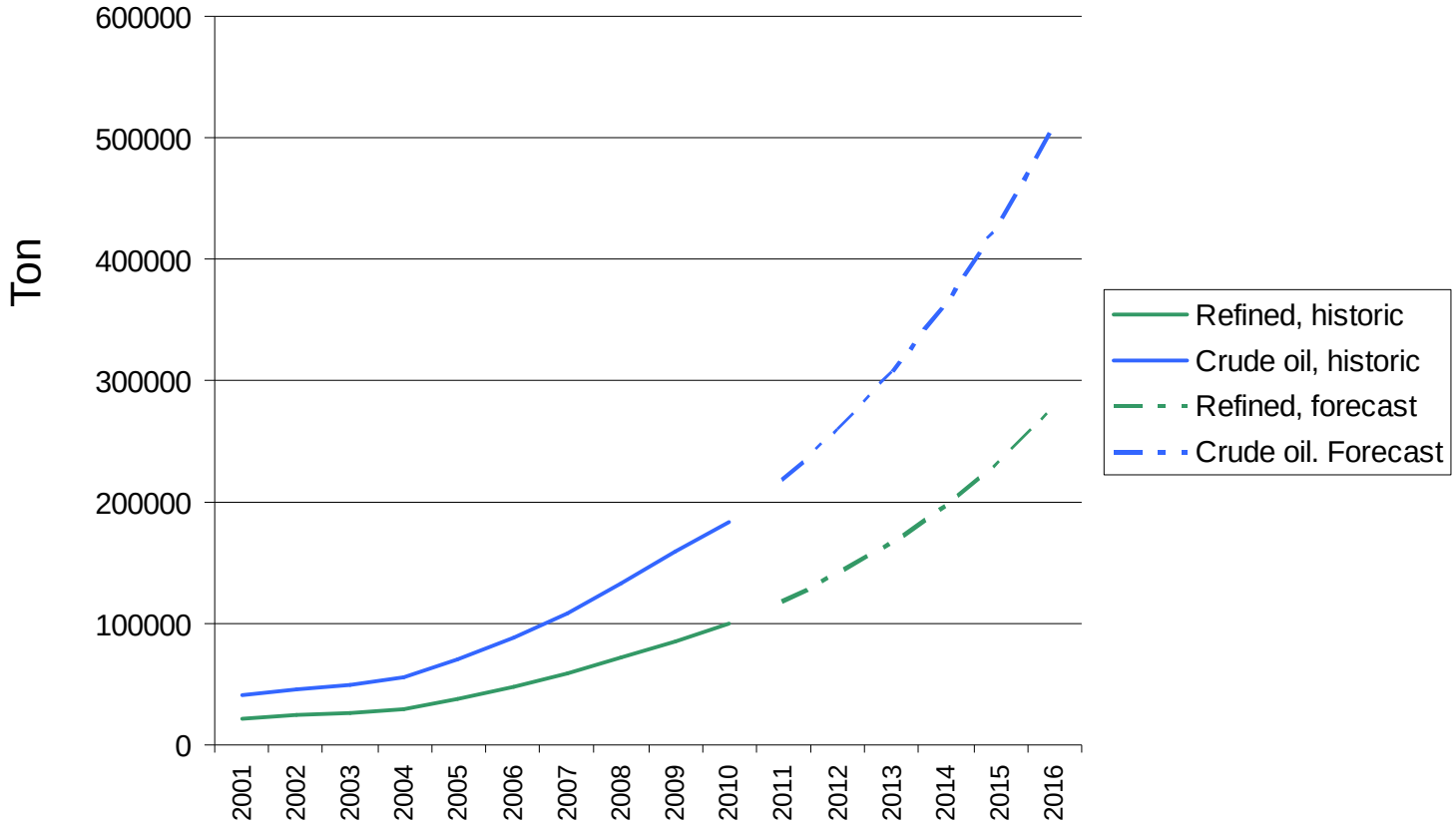
Distribution of crude oil in 2010



The effect of continued fixed growth rates in the demand for refined marine oils for human consumption

KSt1

Illustration



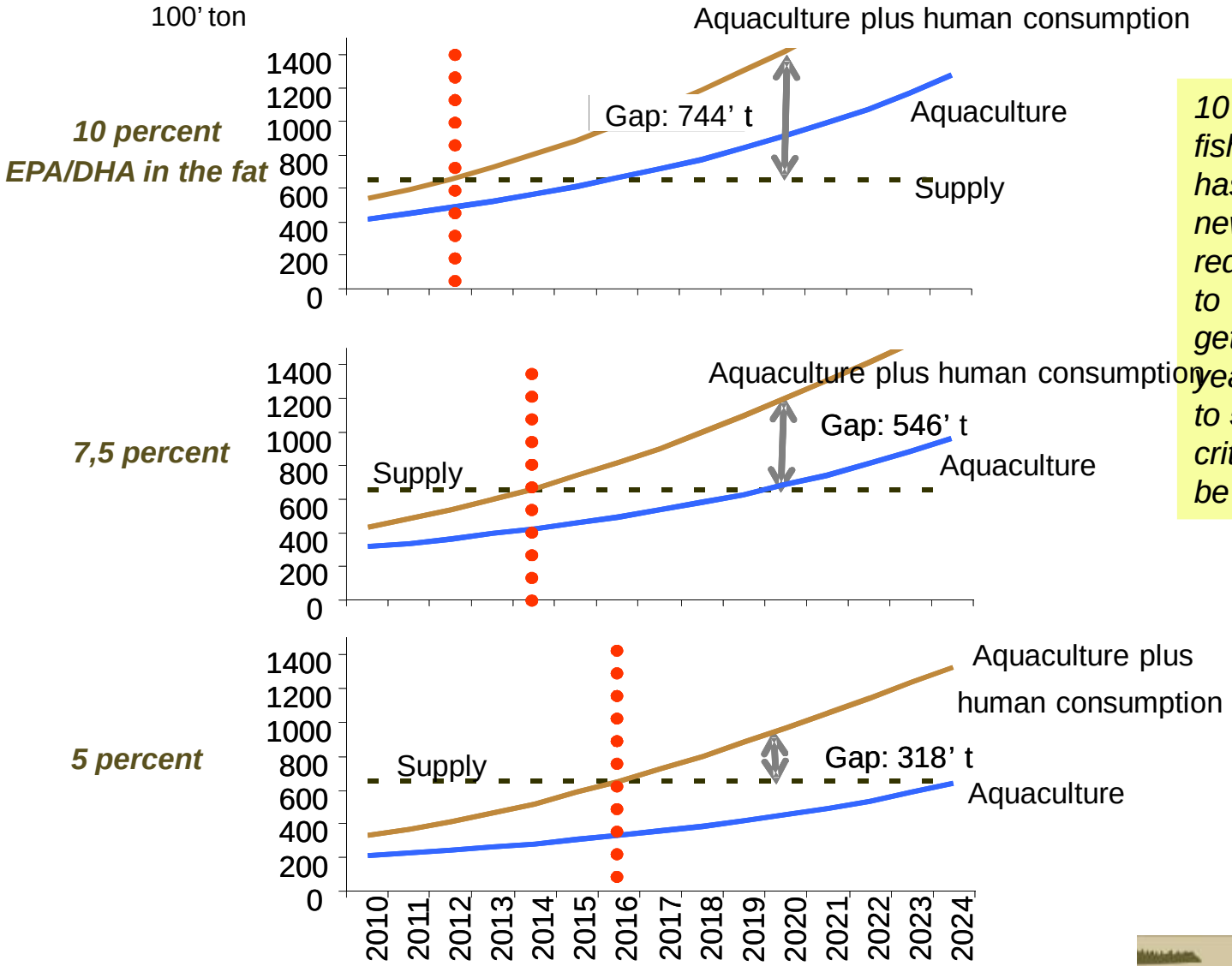
KSt1 Kanskje fjerne dette lysbilde?
Kjell Staven; 10.04.2011

Three scenarios for future use of fish oil

Underlying assumptions:

- Current need for feed: Approx 2,4 mill tones, 5 % growth per year implies 3,9 mill tones in 2020.
- Current standard for salmon feed: 10 % EPA+DHA
- Nutritional supplement
  - Currently 120 000 ton
  - Annual growth of 17 % next 3 years, falling to 7 % over the following seven years.
  - Demanding 3-400 000 tones in 2013
  - Picking the most Omega-3 rich fractions
- Available marine oils for aquaculture holds less EPA /DHA over time: From 20 % EPA/DHA to 15 % over ten years.

Undercoverage and severe increase in substitution can arise quickly



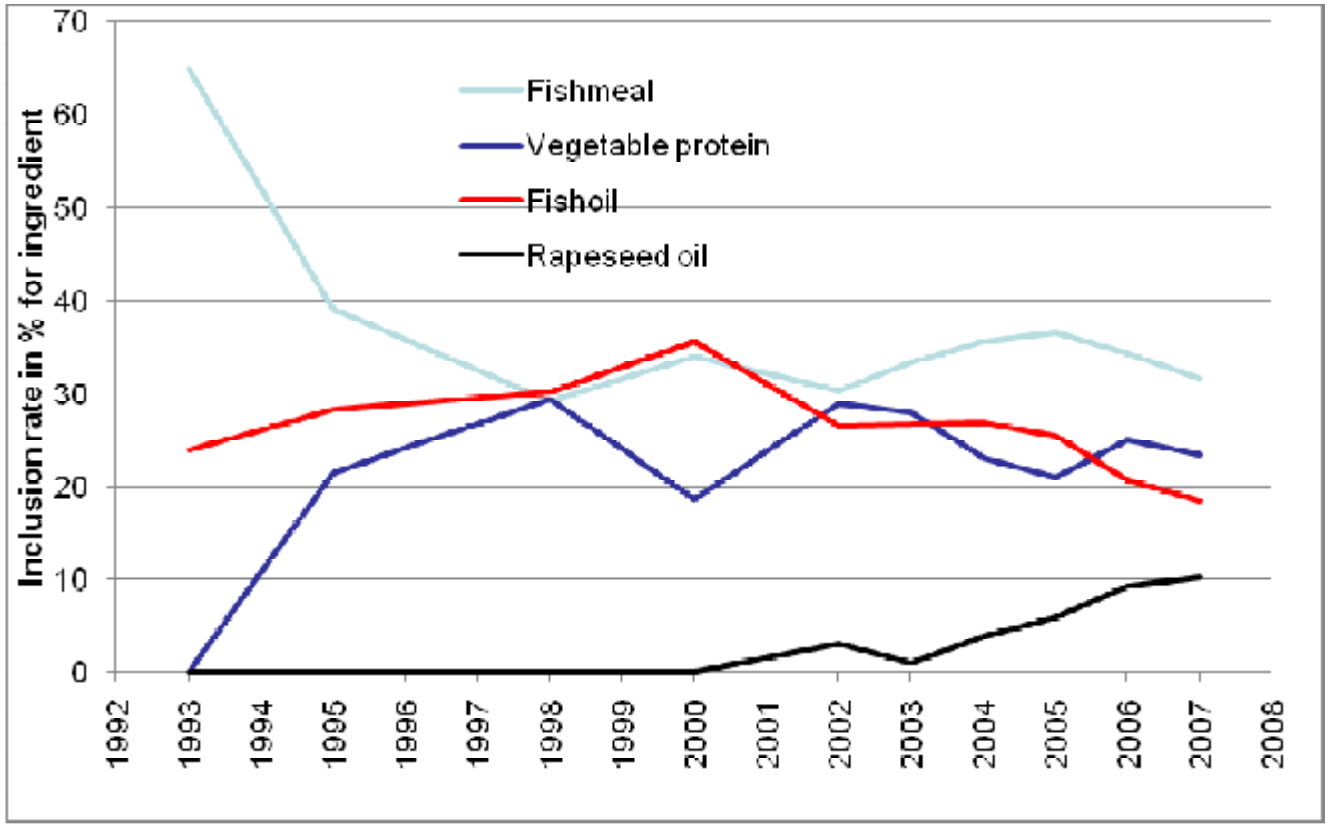
10 % EPA/DHA in the fishfeed, the industry has 2-3 years to find new solutions. A reduction in EPA/DHA to 7,5 %, the industry gets additional two years. Halving, from 10 to 5 % EPA/DHA, the critical undercoverage be moved to 2016.

Current wisdom: Further substitution possible

- *No fish health problems related to feed component substitution*
  - Even towards 3 percent marine fat.
  - Taste and smell is robust.
  - However: Limited experience and research over time.
- *Shifting fat – protein ratios may further enhance the potential for substitution*
  - Regulations stimulate rapid growth in biomass – high protein contents.
  - More flexible feeding may lower the need for fish oil.
- *Labeling regulations provide wide room for substitution*.
  - The label “Source of omega-3 fatty acids” requires only 40 mg EPA+DHA, or 300 mg ALA, per 100 g and 100 kCal.
  - “High omega-3 fatty acids” requires only 80mg EPA+DHA, or 600 mg ALA, per 100 g and 100 kCal.
  - Both label provides room for very low contents of Omega- 3
- *No facts proving severe consumer response to shifts in feed content.*
  - Important risk factor
  - Marketing is critical
  - Limited research.

Increased substitution, the experience

Historical development, inclusion of different ingredients in typical salmonfeed in Europe



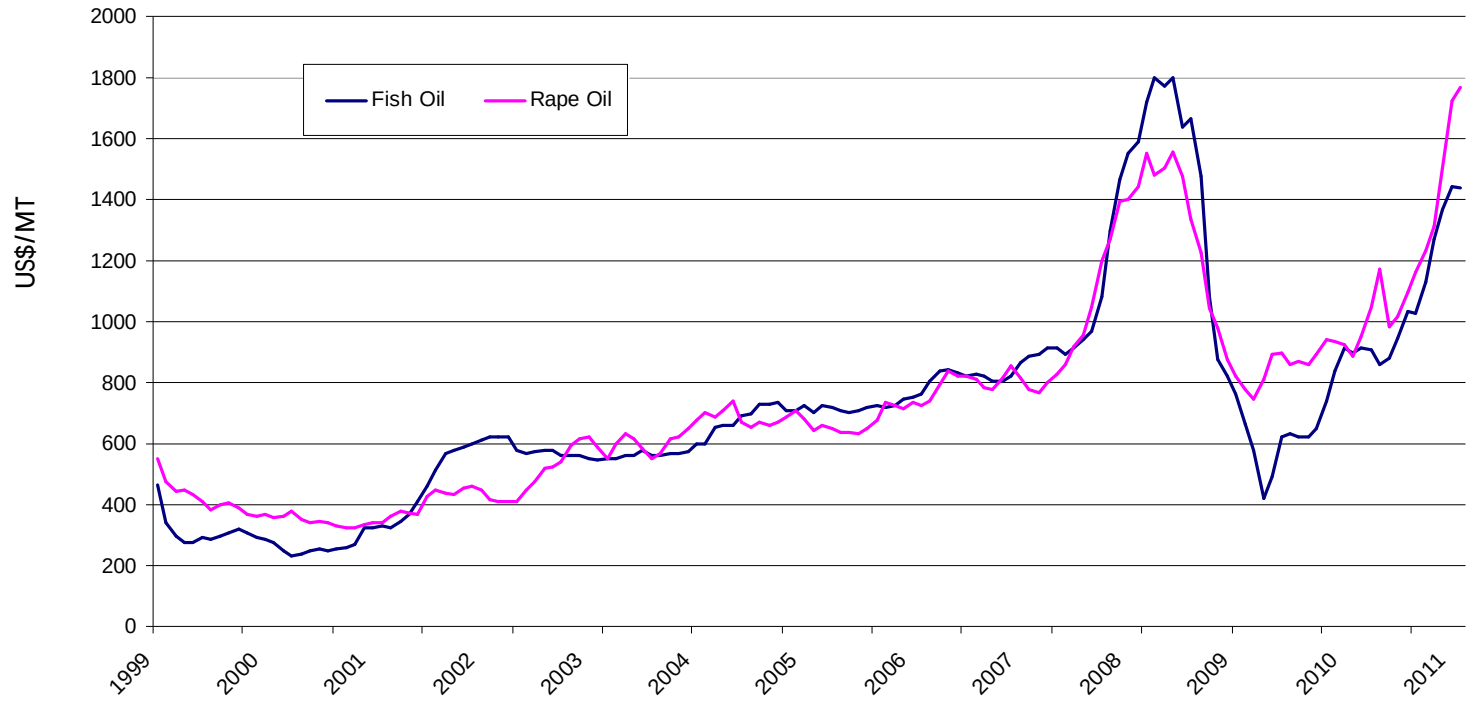
Source: Skretting

A different Salmon Industry

- Higher, more volatile feed costs
- Hunting new sources for Omega 3

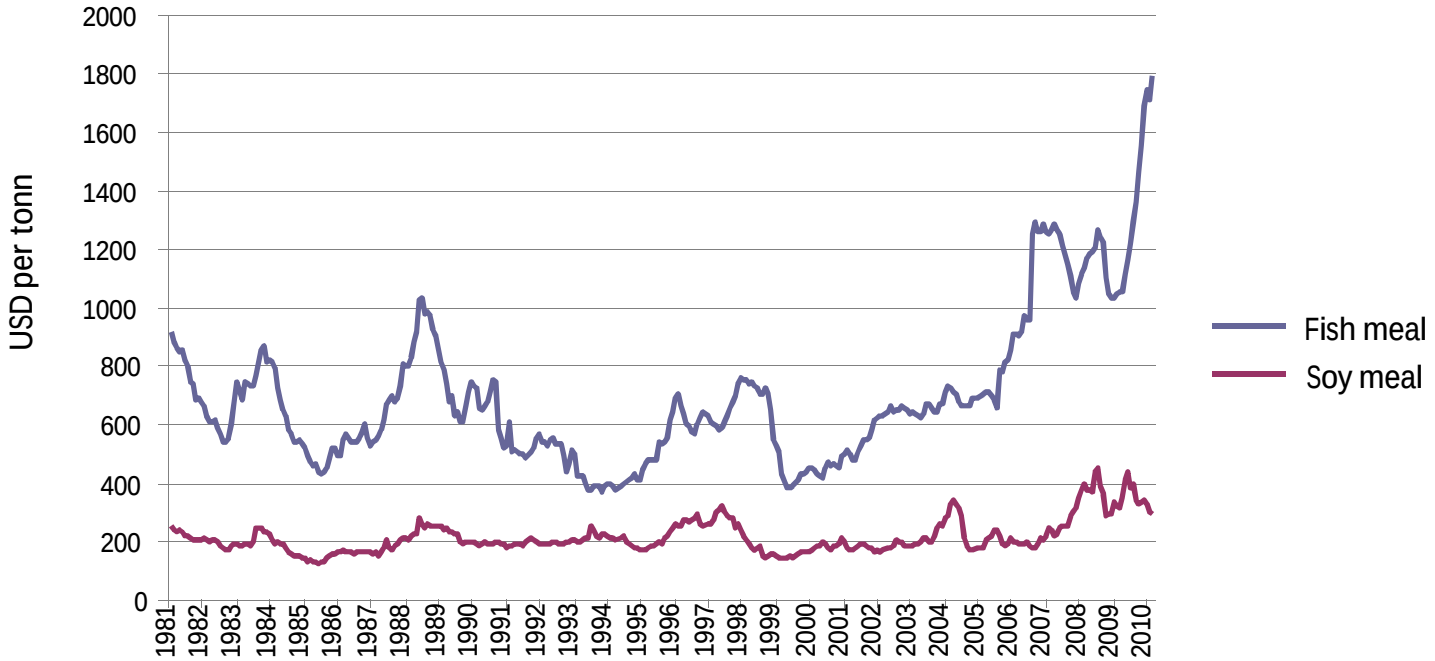
Higher, more volatile prices

- Increased volatility in fish oil prices and rape oil prices
- Parity between the dominating rapeseed oil and marine oil so far
- Shortage will mean a substantial leverage on marine oils compared to rapeseed oil
- Omega 3 will then be priced separated from its general fat content



Higher, more volatile prices

- Inelastic demand ensures volatility if there is variation in supply
- Learn from the relation between fish meal and soy meal



New omega-3 sources

- Krill
- Algae
- Calanus
- GM oil

Intensive chase on new sources with omega-3

Krill:

•Small volumes

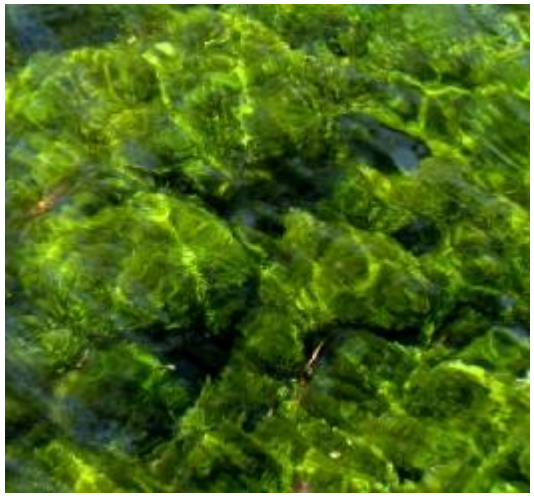
•Possibilities for relative rapid growth.

•It is not yet of interest to market krill oil for fish feed production, because of the premium in the market of human consumption

•Today; possibilities for the fish feed industry to buy krill meal with high content of fat

Algae – fermentation: Expensive with great *potential*:

- Algae-fermentation has probably an indefinite volume potential
- At the present prohibitive costs.
- Using algae in the fish feed is possible, but there are differences between species and some species must be treated before use



Calanus : Norwegian resource with potential

•Potential as a substitute up to 40 percent of the fat in salmon feed.

•Great potential in volume. It is claimed that the production of zooplankton in the Norwegian ocean is about 350–600 millions ton per year.

Intensive chase on new sources with omega-3

GM- omega-3 oils from rapseed oil or soybeen oil:

- The development of GM-oil is very expensive and time consuming

- Uncertain when it can be available on the market, but oils with both EPA/DHA might be available in about ten years

..no sufficient source in sight

Illustration of a tentative supply curve; 2010 and 2020.

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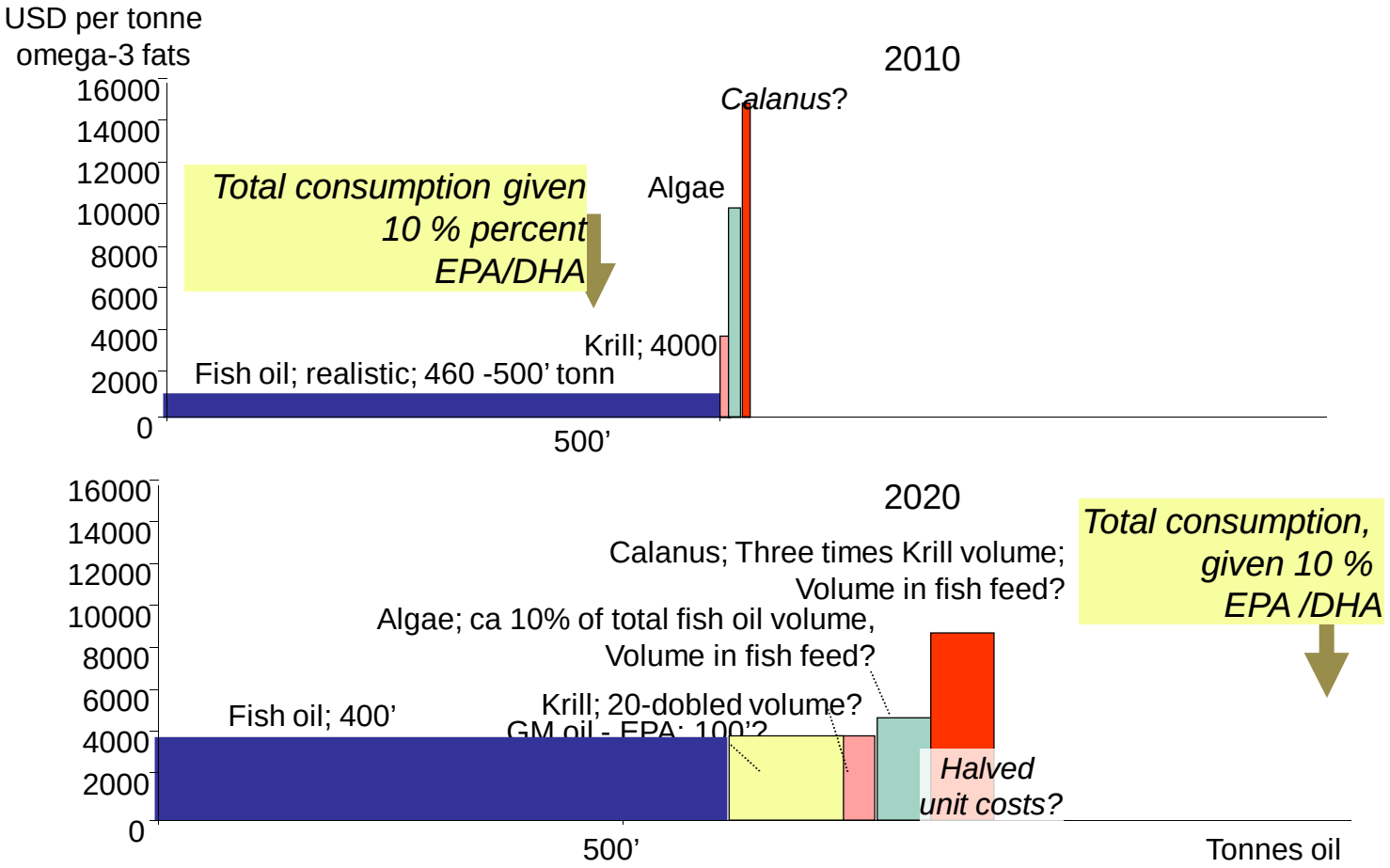

Summing up

- The amount of fish oil is limited
- Fish oil to human consumption will increase

- Comprehensive research
  - Consumer preferences and behavior
  - Potential for substitution in feed
  - Availability of Krill, algae and Calanus